

On an industry-wide basis, the monthly cost of a mobile cellular telephone has declined by even more than carrier charges, from \$79 in 1983 to \$7 in 1991. During the same time, the quality of mobile telephone service was enhanced by improvements in functions and features. When adjusted for inflation, the total cost of owning and using a cellular telephone in 1991 was only 44 percent of its cost in 1983.<sup>15</sup>

It is important to recognize that the growth in subscribership and the reduction in prices have occurred in an industry in which only two firms were licensed to serve each geographic area and the amount of spectrum available to provide cellular service was severely limited by government regulation. However, the industry is about to experience a significant increase both in the number of firms that supply mobile communications services and in the amount of spectrum that has been allocated for this purpose. At least three, and perhaps as many as six, new PCS firms will operate in each geographic area, and the amount of spectrum available for the provision of mobile services will more than triple.

Moreover, even this understates the amount of additional capacity that will be available to serve subscribers since the new operators will use digital technologies that are more efficient than the analog technologies that have been used by incumbent

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<sup>15</sup>Data are from Shosteck, op. cit., and measure the "drive away" price of a single mobile telephone, including antenna, installation, and first-year maintenance.

cellular operators.<sup>16</sup> To this must be added the effect of the introduction of Enhanced Specialized Mobile Radio (ESMR) in the near term and satellite mobile service somewhat later, both of which will add further to the number of firms providing mobile services and the amount of spectrum devoted to this purpose. By any standard, industry concentration will decline greatly -- the question is how soon and by how much -- and limitations on industry growth that have resulted from government-imposed limits on available spectrum will be greatly relaxed.

#### COMPETITION IN CELLULAR SERVICE

Although, at first glance, the predominantly duopolistic structure of the current mobile telecommunications market might tend to raise anticompetitive concerns, the realities of the market dynamics outlined above support the view that there has been substantial competition between the two cellular operators. In seeing how such a result may come about, one must first recognize that the performance of a market can be competitive even when its structure is not. Although economists consider the number and size distribution of firms in a market to be important initial indicators of the likelihood of noncompetitive behavior,<sup>17</sup> a number of characteristics of the supply of cellular services

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<sup>16</sup>Of course, the incumbents are also converting to digital technologies, but the pace at which they can do so is limited by their continuing obligation to provide service to customers with analog equipment.

<sup>17</sup>M. Spence, "Tacit Co-ordination and Imperfect Information," Canadian Journal of Economics XI (1978), pp. 497 and 499.

support the view that competition between cellular operators is substantially more vigorous than is suggested by the duopolistic industry structure.

Economists have identified a number of factors, in addition to the number of its rivals, that influence the strategies each firm pursues, and thus help to determine how close to the competitive outcome the industry's performance will be.<sup>18</sup> Many of these encourage highly competitive behavior even when the number of firms is small, and several of these factors are present in the cellular service industry.<sup>19</sup>

First, the rapid technological change in the provision of cellular service imparts a high degree of variability to the services offered and the prices of those services. When firms are continually modifying, improving, and adding new products and services, the price of each new service must be integrated into the existing price structure. In these circumstances, there may be significant disagreement about the "appropriate" prices to charge for the new services because it is difficult for rivals to

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<sup>18</sup>G. J. Stigler, "A Theory of Oligopoly," Journal of Political Economy 74 (1964), pp. 44-61.

<sup>19</sup>For a more extended discussion of these factors as they apply to the mobile telecommunications services market, see S.M. Besen, R.J. Lerner, and E.J. Murdoch, The Cellular Service Industry: Performance and Competition, Appendix to Reply Comments of the Cellular Telecommunications Industry Association In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, January 1993.

determine what these prices are.<sup>20</sup>

Second, when markets are growing rapidly, the elasticity of demand tends to decline. In such circumstances, which certainly characterize the provision of cellular services, the gains from deviating from a collusive pricing agreement are increased.<sup>21</sup>

Third, with rapid technological innovation, there may be gains to pricing aggressively. These gains arise because a firm can achieve cost savings more rapidly as it moves more quickly down its learning curve, and firms may have difficulty coordinating the rate at which they acquire these learning economies.<sup>22</sup>

Fourth, newcomers in an industry have strong incentives to compete aggressively to attract market shares from existing firms. Early in the history of cellular services, when the wireline carriers already were established and the nonwireline carriers were just beginning to serve customers, the new providers had an especially strong incentive to initiate price reductions. Similarly, aggressive pricing can be expected from PCS entrants as they seek to increase their shares of the mobile services market.

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<sup>20</sup>Rapid technological change may itself be a source of conflict. As Scherer and Ross note: "The more rapidly producers' cost functions are altered through technical change and the more unevenly those changes are diffused throughout the industry, the more likely there will be conflict regarding pricing choices." F.M. Scherer and D. Ross, Industrial Market Structure and Economic Performance, Third Edition (Boston: Houghton Mifflin, 1990), p. 285.

<sup>21</sup>J.J. Rotemberg and G. Saloner, "A Supergame-Theoretic Model of Price Wars During Booms," American Economic Review 76 (1986), pp. 390-407.

<sup>22</sup>A.M. Spence, "The Learning Curve and Competition," The Bell Journal of Economics 12 (1981), pp. 49-70.

Fifth, collusive behavior is generally believed to occur much less frequently in industries, like mobile telecommunications services, in which a significant portion of a firm's costs must be incurred regardless of the level of its output, i.e., when fixed costs are high relative to variable costs.<sup>23</sup> In such circumstances, there are considerable incentives for firms to reduce prices if demand falls short of capacity. Since much investment is both expected, and will have to be made, in anticipation of sizeable demand growth, there are likely to be many situations in which some firms will have substantial excess capacity, precisely the circumstances in which economic analysis indicates that vigorous price competition will prevail.<sup>24</sup>

Finally, although the quality of airtime may not vary significantly across providers, an array of service packages is typically offered. These packages differ by whether or not they include equipment, in the nature of the peak-off peak pricing differentials they contain, and in the discount arrangements, e.g., free weekend service, they provide, among other features. As a result, these packages may not be directly comparable between competing providers.<sup>25</sup> The lack of an obvious basis for comparing

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<sup>23</sup>Scherer and Ross, op. cit., pp. 286-290, discuss the effects of such a cost structure.

<sup>24</sup>It is important to note that excess capacity as defined here in economic terms may differ from engineering estimates of excess capacity.

<sup>25</sup>The quality of airtime will vary from time to time, however, if cellular providers fail to anticipate the growth in subscribers, leading to increased traffic congestion.

service and equipment prices -- which makes it difficult to distinguish price changes that reflect differences in service quality from those that undercut a tacit agreement -- increases the cost of monitoring and punishing deviations from any such agreement.<sup>26</sup>

The combined effect of these factors is to make it difficult for cellular firms to coordinate their pricing behavior. As a result, it would be a mistake to conclude that cellular firms do not compete.

#### PCS, ESMR, AND CHANGES IN MARKET STRUCTURE

It is important to recognize that the advent of PCS will have two logically separable effects on the mobile telecommunications services market. First, it will substantially increase the number of firms and reduce the market shares of the incumbent cellular firms. Second, it will increase the capacity of the industry by adding 120 MHz of spectrum to the 50 MHz now employed by the incumbents. One would generally expect prices to decline as a result of the increase in spectrum availability whether or not the incumbent firms are behaving competitively. The proper test for determining the extent of current competition is to ask how prices would change if the existing amount of spectrum were divided among a larger number of firms.

The structure of the mobile telecommunications services

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<sup>26</sup>K.W. Clarkson and R.L. Miller, Industrial Organization: Theory, Evidence, and Public Policy (New York, NY: McGraw-Hill Book Company, 1982), pp. 335-336.

industry will become substantially less concentrated with the advent of PCS services, and competition will become even more vigorous. Given the wide range of mobile telecommunications services, the best approach to developing a market definition is from the supply side.<sup>27</sup> Because there is substantial supply-side substitutability, so that all mobile telecommunications licensees - including those providing cellular, PCS, and Specialized Mobile Radio services -- can provide the same range of services, they should all be considered as being in the same antitrust market.<sup>28</sup> In these circumstances, the capacity of each firm to transmit information over its licensed bandwidth, without regard to the uses to which that bandwidth is put, is the correct measure of firm shares, and market concentration can be measured using these

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<sup>27</sup>Market definition generally follows the approach in the "Department of Justice and Federal Trade Commission Horizontal Merger Guidelines," Special Supplement, Antitrust & Trade Regulation Report, Published and Released on April 2, 1992. A market is defined as "a product or group of products such that a hypothetical profit-maximizing firm that was the only present and future seller of those products ('monopolist') likely would impose at least a 'small but significant and nontransitory' increase in price." If such a hypothetical monopolist would not find the price increase to be profitable, "then the Agency will add to the product group the product that is the next-best substitute....The Agency generally will consider the relevant product market to be the smallest group of products that satisfies the ['small but significant and nontransitory' increase in price] test." Market definition has both product and geographic dimensions.

<sup>28</sup>For a more extended discussion of the principles of market definition and their application to the mobile telecommunications services market, see S.M. Besen and W.B. Burnett, "An Antitrust Analysis of the Market for Mobile Telecommunications Services," Appendix A to Petition for Reconsideration of the Cellular Telecommunications Industry Association In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services, December 8, 1993.

shares.<sup>29</sup>

The key to this conclusion is that providers are legally able to shift or substitute rapidly among the various services available for provision, and can do so at modest cost. If all firms can easily offer the same range of services, they are in the same market.

A number of factors support the view that all mobile service providers -- cellular, PCS, and ESMR -- are in the same market:<sup>30</sup> (1) the absence of legal or regulatory restrictions on spectrum use, permitting a licensee to shift from provision of one mobile service to another in response to a service price increase; (2) the ability to use all portions of the electromagnetic spectrum allocated to the provision of mobile services to provide all of the same services and at similar costs ("bandwidth fungibility"); (3) the ability of suppliers to obtain equipment that can be used to provide more than one service, a factor that will be enhanced by the introduction of Cellular Digital Packet Data (CDPD) modules; and (4) the ability of consumers to obtain equipment that can be used to obtain service from suppliers using different frequencies, a factor that is enhanced by the FCC's decision to consolidate PCS assignments in a continuous band.

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<sup>29</sup>It must be noted that there is not a one-to-one correspondence between bandwidth and capacity. The capacity to transmit information is a function both of bandwidth and the technology used; analog technologies are inherently less capable than digital technologies. Capacity is based on effective bandwidth.

<sup>30</sup>Besen and Burnett, op. cit., discusses these factors in more detail.



After the market is defined, shares must then be assigned to each supplier in order to measure market concentration. As mentioned above, effective capacity to transmit information is the appropriate measure of market shares within the market for mobile telecommunications services, particularly given the ease with which firms may switch from the provision of one service to another.<sup>31</sup> The decision by the Commission to award licenses to PCS providers, combined with the introduction of ESMR, will greatly expand the number of firms supplying mobile telecommunications services in each geographic area within the United States and will dramatically reduce the level of market concentration.

Measuring the magnitude of the change can be demonstrated by comparing the current Herfindahl-Hirschman Index (HHI), the sum of the squared market shares of the incumbent cellular operators, with the HHI that will prevail after the introduction of PCS and ESMR.<sup>32</sup> The current HHI is 5000, since each of the incumbents has

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<sup>31</sup>Within a given allotment of spectrum, newer, digital systems have a far greater capacity than do older, analog ones. Because incumbent cellular operators will, for some time, be required to continue to serve customers that have invested in analog equipment, they will have lower effective capacity and market share per unit of allocated bandwidth than will firms with licenses for the same amount of bandwidth that employ only digital equipment. Existing cellular operators will suffer this "analog handicap" for as long as they must serve customers using the old technology. The share of the mobile telecommunications market held by cellular firms will be less than their share of assigned bandwidth, and this factor must be taken into account in measuring market concentration and the effects of spectrum license acquisitions.

<sup>32</sup>The HHI is the most widely used measure of market concentration and appears prominently in the DOJ/FTC Horizontal Merger Guidelines.

one-half of industry capacity.<sup>33</sup> The significant reduction in the HHI that will accompany the introduction of PCS and ESMR can be expected to increase industry competitiveness.

Ignoring ESMR for the moment and concentrating solely on PCS, the "worst," i.e., most concentrated, case, occurs where each of three newcomers acquires licenses to use both a 30 MHz and a 10 MHz assignment, the maximum bandwidth that can be acquired under FCC rules. Even in this case, the HHI declines by more than half to 2278.<sup>34</sup> Significantly, the cellular carriers each have only about 11 percent of industry capacity while each of the newcomers has more than 26 percent.

In the "best," i.e., least concentrated, case, three new licensees each have a 30 MHz allocation and three new licensees each have a 10 MHz allocation. In these circumstances, the HHI is 1514, less than one-third of what it had previously been<sup>35</sup>, with the cellular carriers again each having only an 11 percent share.

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<sup>33</sup>The HHI is calculated as  $2(50)^2$ , since each of the two cellular suppliers is licensed to use 50 percent of industry capacity. In this calculation, we ignore the presence of other suppliers of mobile services, which has the effect of increasing the HHI.

<sup>34</sup>This assumes that digital capacity has 6 times the throughput as analog and that the incumbent cellular carriers must reserve 10 MHz to service customers using analog equipment. The details of this and the following calculations are presented in Tables 1 and 2. D.P. Reed, Putting It All Together: The Cost Structure of Personal Communications Services (Federal Communications Commission, Office of Plans and Policy, November 1992, pp. 66-69) provides references to many of the estimates of the advantages of digital over analog transmission.

<sup>35</sup>Actually, concentration can be less than this if the initial PCS licenses are subdivided. The calculations presented here are conservative in that they assume no subdivision occurs.

Indeed, even if a cellular carrier were to acquire a 10 MHz allocation, the maximum it can obtain, its share would rise to somewhat less than 18 percent, which would still be smaller than the share of each of the three newcomers with a 30 MHz allocation.<sup>36</sup>

When ESMR is taken into account, the market becomes even less concentrated. If the ESMR is assigned a bandwidth of 10 MHz, the worst case HHI is 2045 and the best case HHI is only 1370. Here, the share of an incumbent cellular carrier is reduced to only about 10 percent if it does not acquire a 10 MHz license, and it is somewhat less than 17 percent if it does. By contrast, a PCS newcomer with a 30 MHz license has a share of more than 18 percent, while one with both a 30 MHz and a 10 MHz license has a share of more than 24 percent.

These calculations strongly support two conclusions. First, overall industry concentration will decline greatly as the result of the introduction of PCS and ESMR, with the precise extent determined by the identities of the successful bidders in the PCS auctions and on transactions in the aftermarket. In no case does the HHI fall by less than half, and it could decline by more than two-thirds. Second, the shares of the incumbent cellular operators, as measured by their shares of effective capacity, will

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<sup>36</sup>The reason, as mentioned, is the continuing analog obligation.

decline precipitously with the introduction of PCS and ESMR.<sup>37</sup>

### Conclusion

We are about to enter a new era in which the number of firms supplying mobile telecommunications services will more than double, effective industry capacity will increase more than fourfold, measured industry concentration will decline by more than half, and the share of the effective capacity of the industry licensed to each of the two current cellular providers will decline by more than two-thirds. As the number of carriers increases, and industry concentration as measured by the HHI declines, the industry is likely to become more competitive. Given the quite remarkable performance of the cellular industry with only two carriers and much more limited capacity, the future of the mobile services industry is likely to be especially bright, with firms offering a wide array of new services and even lower prices than in the past for existing ones. In these circumstances, the best approach for regulators is to eliminate regulatory-imposed barriers to entry as rapidly as possible so that competitive market forces can determine the performance of the industry. Regulators would be at odds with developing market forces if they were to impose more stringent

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<sup>37</sup>We do not mean to suggest that the newcomers share of output will increase as rapidly as will their share of capacity. The point is, rather, that the existence of this large amount of capacity will immediately serve to discipline the pricing behavior of the incumbent cellular operators. The behavior of their output shares will depend in part on how they adjust their prices to the new entry. It should also be emphasized here that prices will likely fall simply because of the large increase in capacity.

requirements on cellular carriers just as industry concentration is declining so dramatically.

**Table 1**

**HHI Calculations Without ESMR**  
**Digital : Analog / 6 : 1**  
**Cellular Operators' Bandwidth Devoted to Analog : 10 MHz**

Firms	Bandwidth	Effective Capacity*	Market Share	HHI Contribution	Bandwidth	Effective Capacity*	Market Share	HHI Contribution
Cellular 1	25	100	10.9%	118	25	100	10.9%	118
Cellular 2	25	100	10.9%	118	25	100	10.9%	118
3	30	180	19.6%	383	40	240	26.1%	681
4	30	180	19.6%	383	40	240	26.1%	681
5	30	180	19.6%	383	40	240	26.1%	681
6	10	60	6.5%	43	0	0	0.0%	0
7	10	60	6.5%	43	0	0	0.0%	0
8	10	60	6.5%	43	0	0	0.0%	0
<b>Totals</b>	170	920		1,512	170	920		2,278

\* Effective Capacity is defined as bandwidth devoted to digital multiplied by the ratio of digital's advantage over analog plus bandwidth devoted to analog.

SOURCES: FCC, Second Report and Order; Charles River Associates.

**Table 2**

**HHI Calculations With ESMR**  
**Digital : Analog / 6 : 1**  
**Cellular Operators' Bandwidth Devoted to Analog : 10 MHz**

Firms	Bandwidth	Effective Capacity*	Market Share	HHI Contribution	Bandwidth	Effective Capacity*	Market Share	HHI Contribution
Cellular 1	25	100	10.2%	104	25	100	10.2%	104
Cellular 2	25	100	10.2%	104	25	100	10.2%	104
3	30	180	18.4%	337	40	240	24.5%	600
4	30	180	18.4%	337	40	240	24.5%	600
5	30	180	18.4%	337	40	240	24.5%	600
6	10	60	6.1%	37	0	0	0.0%	0
7	10	60	6.1%	37	0	0	0.0%	0
8	10	60	6.1%	37	0	0	0.0%	0
ESMR 1	10	60	6.1%	37	10	60	6.1%	37
<b>Totals</b>	180	980		1,370	180	980		2,045

\* Effective Capacity is defined as bandwidth devoted to digital multiplied by the ratio of digital's advantage over analog plus bandwidth devoted to analog.

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SOURCES: FCC, Second Report and Order; Charles River Associates.

**CERTIFICATE OF SERVICE**

I, Nancy L. Killien, do hereby certify that a copy of the foregoing "Comments of GTE Service Corporation" was hand-delivered this 12th day of September, 1994 to the following:

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Commissioner James H. Quello  
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